ARSENIC (III) OXIDE CRYSTAL OBTAINED FROM TECHNOLOGICAL WASTE: PHOTOLUMINESCENCE

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Abstract: Arsenic (III) oxide was obtained from vapor stream at processing technological waste in manufacturing of the gallium arsenide epitaxial structure. It has a cubic crystal structure, elementary cell a=11.05(4)Å, Fd3m space group. The photoluminescence spectra of the arsenic oxide contains a band with the maximum 2.69 eV that doesn't depend on temperature in the interval 77-300 K. The width of the band is 0.75 eV. The intensity of illumination with energies lower than 2.32 eV at 77 K is higher. Perhaps it can be utilized in opto electronic device designing.

Keywords: *Arsenic (III) oxide crystal, Technological Waste, Photoluminescence.*

INTRODUTION

The microelectronic industry in Republic of Moldova can be rehabilitated only by the introduction of advanced technologies and new semiconductor materials, developed by local scientists or imported from abroad. In this aspect is interesting the manufacture of ultra-fast gallium arsenide (GaAs) power devices elaborated by Informinstrument SA [1] using the chemical technologies with gas transport (the chlorine method). For cutting down heavy expenses of materials in the epitaxial technology the authors [2] has been elaborated a technological cycle of wasters processing with relatively pure materials, that constituted about 70 % from the initial materials involved in the manufacture [3], and recovery the metallic gallium and arsenic trichloride from the wastes. The technological process allows as well to obtained arsenic oxide – an intermediate crystalline substance with semiconductor properties that represents the study object in the report.

1. ARSENIC (III) OXIDE CRYSTALLIZATION

The mono crystal of arsenic oxide was obtained with dimensions about 3x3 mm^2 from technological epitaxial wastes by vaporization method at temperature less that 300 ^oC in the growth section of the reactor. It is transparent, does not dissolve in water and acetone, but it dissolves in alcohol. The electric resistance on the surface of the crystal is 2,5-2,9 * 10^8 Ohm*cm.

2. EXPERIMENTAL RESULTS AND DISCUSSION

2.1. Structure of the mono crystal

The structure of the obtained arsenic oxide mono crystals was studed by X-raying method using the DRON-UM instrument of diffraction (Cu Kα-radiation, Ni-sifter, θ-2θ-scaning). The specimens were prepared by the standard method. The Miller indexes and inter-plane distance corresponded to the diffraction maximums shown on X-ray pattern in tab. 1.

Table1. The inter-plane distance of arsenic (III) oxide mono crystal

Number of Peak	Miller index hkl	Inter-plane distance, d (Å)
1.	111	6.3905
2.	220	3.3356
3.	222	3.2000
4.	222	2.9374
5.	400	2.7698
6.	331	2.5402
7.	422	2.2607
8.	511	2.1236
9.	440	1.9569
10.	531	1.8690
11.	442	1.8441
12.	622	1.6695
13.	444	1.5968
14.	551	1.5498
15.	731	1.4400
16.	733	1.3520
17.	660	1.3042

The elementary cell a=11.05(4)Å was specify by the method of least squares using PDP-11 programs (University of Parma, Italy). The specimens have the cubic crystal structure, Fd3m space group, Sb_4O_6 structure model. The results was identified to the Inorganic Crystal Structure Database (ICSD): Refcod 2114, a=11.07(4)Å.

2.2. Photoluminescence

The arsenic oxide luminescence was excited with nitrogen laser LGI-21 with 337 nm wavelengths at 300 K and 77 K. The spectrum analysis of the specimens was performed with MDR-23 monochromator and as receptor it was used the FAU-51 photomultiplier corrected in conformity of the spectral sensitivity of the receptor.

Characteristic for all samples is the fact that light intensities at different temperatures do not differ essentially for instance at 77 K and 300 K. In fig. 1 is presented the photoluminescence spectrum of the arsenic (III) oxide, prepared according to the mentioned conditions. The spectrum

contains a wide band with the width of 0.75 eV at the level 0.5 and is centered around the value 2.69 eV at 300 K. The part of the band from the low energies, starting with E = 2.32 eV is extended with a higher intensity at the 77 K temperature.

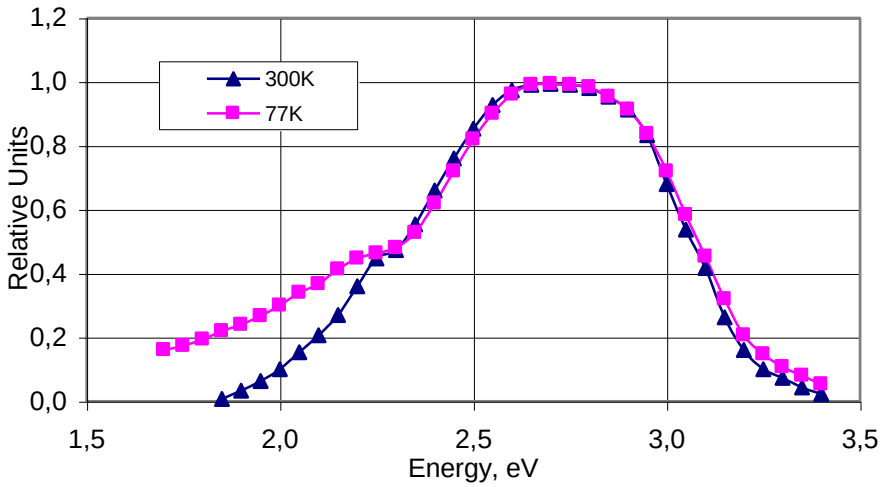

Fig. 1. The photoluminescence spectrum of the arsenic (III) oxide.

4. CONCLUSION

The photoluminescence spectra of arsenic (III) oxide showed in this paper coincides with the gallium arsenate [4] photoluminescence spectra, obtained from liquid technological wastes in manufacturing of the gallium arsenide epitaxial structures. It is possible that the preparation process of the patterns in [4] stimulates crystallizing of arsenic oxide, which irradiates at excitation with the 337 nm light stream. Perhaps this once can be utilized in opto electronic device designing.

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